WHAT IS CLAIMED IS:

1.    A control system for a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the control system comprising:

at least one ultraviolet (UV) sensor to be positioned adjacent to a combustion flame source in the combustion chamber of a heating system for generating analog signals indicative of the quality of the combustion flame based on the characteristics of UV light generated by the combustion flame;

means communicating with the at least one UV sensor for converting the analog signals into digital signals indicative of the quality of the combustion flame based on the characteristics of UV light generated by the combustion flame;

means for performing numerical and logical operations on the digital signals, so as to result in data that precisely correlates in a linear fashion with the carbon dioxide content in the combustion gases; and

means for tracking changes in the flame quality from an initial setup optimal value, as correlated with the measured and computed carbon dioxide content of the combustion gases.

2.    A control system as defined in claim 1, wherein the digital signals include control signals for regulating the quality of the combustion flame.

3.    A control signal as defined in claim 2, wherein the control signals are for regulating the on and off operation of at least one of the igniter, the fuel valve, the air blower and the fuel pump.

4.    A control system as defined in claim 1, wherein the communicating means and the performing means is a microcontroller.

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5.     A control system as defined in claim 1, wherein the performing means includes determining from the digital signals the highest intensity frequencies of UV light generated by the combustion flame.

6.     A control system as defined in claim 1, wherein the performing means includes determining from the digital signals the average intensity of UV light generated by the combustion flame.

7.     A control system for a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the control system comprising:

at least one ultraviolet (UV) sensor to be positioned adjacent to a combustion flame source in the combustion chamber of a heating system for generating signals indicative of the quality of the combustion flame based on the characteristics of UV light generated by the combustion flame;

means for transmitting the signals to a remote processor via a modem over a global communications network; and

means at the remote processor for employing data carried by the transmitted signals to aid service personnel responsible for fuel delivery or heating system repair in servicing the heating system.

8.     A control system as defined in claim 7, wherein the transmitting means includes a modem.

9.     A control system as defined in claim 8, wherein the modem includes a hybrid DAA circuit for interfacing the modem to the global communications network.

10.     A control system as defined in claim 7, wherein the data carried by the transmitted signals includes at least one of fuel valve on time, flame quality parameters, and exception to normal operation data requiring need for immediate service.

11.     A control system as defined in claim 7, wherein the employing means includes using data carried by the transmitted signals in conjunction with non-transmitted data originating from the service personnel to determine fuel delivery dates.

12.     A control system as defined in claim 11, wherein the non-transmitted data includes at least one of heating degree-day information, date of last fuel delivery, and modifier constants for each heating control system customer to fine-tune the prediction accuracy of fuel delivery dates based on the operational history for each customer.

13.     A control system as defined in claim 10, wherein the flame quality parameters include at least one of highest intensity frequencies of UV light from the combustion flame, average intensity of UV light from the combustion flame, and the average exhaust gas stack temperature.

14.     A control system as defined in claim 13, wherein the means for employing data includes analyzing the highest intensity frequencies of UV light from the combustion flame, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation.

15.     A control system as defined in claim 13, wherein the means for employing data includes analyzing the highest intensity frequencies, the average

flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with less than optimal performance so as to require servicing at a predicted future date.

16.     A control system as defined in claim 13, wherein the means for employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with less than optimal performance so as to require servicing immediately, but without shutdown.

17.     A control system as defined in claim 13, wherein the means for employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with unacceptable performance requiring immediate shutdown.

18.     A control system as defined in claim 13, wherein the means for employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation for calculating the rate of change of the values to determine the next service date.

19.    A control system as defined in claim 16, wherein the exception to normal operation data requiring the need for immediate service includes at least one of a lockout condition, the presence of combustion flame prior to start-up, and an indication from a control system self-diagnostic that the control system is faulty.

20.    A method of controlling a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the method comprising the steps of:

positioning at least one ultraviolet (UV) sensor adjacent to a combustion flame source of a combustion chamber of a heating system, and generating from the at least one UV sensor analog signals indicative of the quality of the combustion flame based on the characteristics of UV light generated by the combustion flame;

converting the analog signals into digital signals indicative of the quality of the combustion flame based on the characteristics of UV light generated by the combustion flame;

performing numerical and logical operations on the digital signals, so as to result in data that precisely correlates in a linear fashion with the carbon dioxide content in the combustion gases; and

tracking changes in the flame quality from an initial setup optimal value, as correlated with the measured and computed carbon dioxide content of the combustion gases.

21.    A method as defined in claim 20, further including the steps of:

transmitting the digital signals to a remote processor via a global communications network; and

employing data carried by the transmitted signals to aid service personnel responsible for fuel delivery or heating system repair in servicing the heating system.

22.     A method as defined in claim 21, wherein the data carried by the transmitted signals includes at least one of fuel valve on time, flame quality parameters, and exception to normal operation data requiring need for immediate service.

23.     A method as defined in claim 21, wherein the step of employing data includes using data carried by the transmitted signals in conjunction with non-transmitted data originating from the service personnel to determine fuel delivery dates.

24.     A method as defined in claim 23, wherein the non-transmitted data includes at least one of heating degree-day information, date of last fuel delivery, and modifier constants for each heating control system customer to fine-tune the prediction accuracy of fuel delivery dates based on the operational history for each customer.

25.     A method as defined in claim 22, wherein the flame quality parameters include at least one of highest intensity frequencies of UV light from the combustion flame, average light intensity of UV light from the combustion flame, and the average exhaust gas stack temperature.

26.     A method as defined in claim 25, wherein the step of employing data includes analyzing the highest intensity frequencies of UV light from the combustion flame, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation.

27.     A method as defined in claim 25, wherein the step of employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with less than optimal performance so as to require servicing at a predicted future date.

28.     A method as defined in claim 25, wherein the step of employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with less than optimal performance so as to require servicing immediately, but without shutdown.

29.     A method as defined in claim 25, wherein the step of employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous servicing operation to determine whether the percentage shift in values exceeds predetermined thresholds associated with unacceptable performance requiring immediate shutdown and immediate service.

30.     A method as defined in claim 25, wherein the step of employing data includes analyzing the highest intensity frequencies, the average flame intensity, and the exhaust gas stack temperature for the percentage shift in values from optimal respective frequencies, intensity, and temperature as established during the previous

servicing operation for calculating the rate of change of the values to determine the next service date.

31.     A method as defined in claim 22, wherein the exception to normal operation data requiring need for immediate service includes at least one of a lockout condition, the presence of combustion flame prior to start-up, an indication from a control system self-diagnostic that the control system is faulty, and an indication that a flame quality or stack temperature threshold has been reached that does not require shutdown, but does require immediate service.

32.     A control system for a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the control system comprising:

a relay circuit having first and second relays, connected in series for redundancy of function to enable shutdown (open-circuiting) in the event of a failure, each of said relays having an open position and a closed position, the energy source being connected to a motor for the air blower and the fuel pump through said first and second relay when said relays are closed;

a relay contact position monitor in circuit with said relays, designed to output a signal when said relays are in their proper off position, yet having no sensing current flow out to said motor when said relays are in their normally off position; and

a relay control circuit designed to provide power to turn on said relays in response to a call for heat from a thermostat and said signal from the relay contact monitor.

33.     The control system of claim 32, wherein said relay contact position monitor includes a switching device, configured to sense voltages applied across

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contacts of the relays, deriving predetermined current flow levels through said switching device, depending on contact positions of the relays.

34.     The control system of claim 33, where said switching device is an optoisolator.

35.     The control system of claim 34, wherein said optoisolator includes a voltage level controlled input current driver, including a resistor and zener diode, and a voltage level generating circuit, including three resistors, all connected across said relay contacts.

36.     The control system of claim 33, in which said switching device includes an isolated output transistor through which the switching device delivers a signal to said relay control circuitry.

37.     A method of controlling a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the method comprising the steps of:

positioning a relay circuit having first and second relays, connected in series for redundancy of function to enable shutdown (open-circuiting) in the event of a failure, each of said relays having an open position and a closed position, an energy source being connected to a motor for the air blower and the fuel pump through said first and second relay when said relays are closed;

generating a first square-wave pulse train signal when said relays are in their proper off position, yet having no sensing current flow out to said motor when said relays are in their normally off position; and

generating a second square-wave pulse train signal different from said first square-wave pulse train signal when said relays are not in their proper off position.

38.     A method as defined in claim 37, wherein the first square-wave pulse train signal for normally off relays, being generated by an optocoupler, includes a repetitive train of 8.3 millisecond high voltage pulses, followed by 2.5 millisecond off pulse, a 3 millisecond high voltage pulse, and a 2.5 millisecond off pulse.

39.     A method as defined by claim 37, wherein said first and second square-wave pulse train signals are used to distinguish properly functioning said relays from improperly functioning said relays, so as to shutdown the control operation, should said improper relay functioning be detected.

40.     A method of controlling a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the method comprising the steps of:

generating two independent input signals from one optoisolator by means of alternating the input of said signals, and

synchronizing a reference power line voltage phase with each input signal, so as to distinguish one signal from the other, depending on which line voltage polarity is present.

41.     A control system for a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the control system comprising:

means of detecting a telephone-in-use state, prior to telecommunication initiation, without the need for going 'off hook', and creating noise on the telephone line that may be in-use for voice, fax, or other telecommunications purposes.

42.     The control system of claim 41, where said means of detection of line-in-use comprises a modified ring detect circuit which includes an optocoupler driven by a resistor-capacitor circuit across the telephone line tip and ring

connections, with said modification including the addition of a voltage limiting device in series with said resistor-capacitor circuit.

43.     The control system of claim 42, where said voltage limiting device includes a zener diode of sufficiently low voltage limiting value so as to allow ring detection under worst case voltages, yet sufficiently high value to distinguish a line-in-use state from a line-not-in-use state.

44.     A method of controlling a heating system including a combustion chamber, a thermostat, an igniter, an air blower, and a fuel pump, the method comprising the steps of:

generating a high direct current voltage signal through an optoisolator across a telephone input line when all telecommunications systems on said line are not in use (on hook), and;

generating a low direct current voltage signal through an optoisolator across a telephone input line when another telecommunications system on said line is already in use (off hook), and;

generating an alternating voltage signal from the same said optoisolator when a normal incoming call ring signal is detected.